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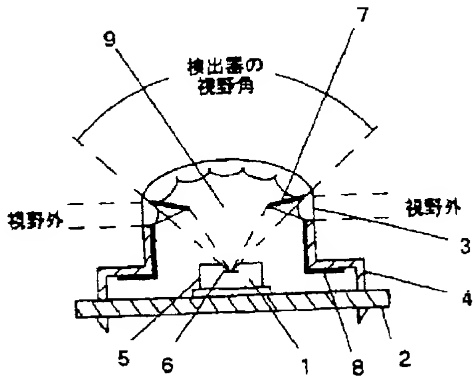
(54)【発明の名称】　赤外線検出装置

(57)【要約】
【課題】従来構造より大型化せず、また、コストを比較的低く抑えることができ、赤外線検出範囲を広角度に設定できる赤外線検出装置を提供することとである。
【解決手段】赤外線検出器と集光レンズを備えてなる赤外線検出装置において、集光レンズは赤外線検出器の視野前方に配置され、集光レンズと前記赤外線検出器との間には赤外線反射器を備えており、この赤外線反射器はウイング状に加工形成され、赤外線検出器の視野前方の一部分に切除部を有している赤外線検出装置。



【特許請求の範囲】
【請求項1】赤外線検出器と集光レンズを備えた赤外線検出装置において、
前記集光レンズは、前記赤外線検出器の視野前方及び視野外に配置されており、
前記集光レンズと前記赤外線検出器との間には、ウイング状赤外線反射器を備え、
該赤外線反射器は、前記赤外線検出器の視野前方に切除部を有していることを特徴とする赤外線検出装置。
【請求項2】前記赤外線検出器は焦電形検出素子からなることを特徴とする請求項1の赤外線検出装置。
【請求項3】前記集光レンズは複数個のレンズの集合体からなり、
前記赤外線検出器の視野内のレンズによって集光された赤外線が前記切除部を通して赤外線検出器に入射し、
前記赤外線検出器の視野外のレンズによって集光された赤外線が前記赤外線反射器に反射し赤外線検出器に入射するように配置されていることを特徴とする請求項1または2に記載の赤外線検出装置。
【請求項4】前記赤外線反射器は、前記赤外線検出器の中心に対して略左右対称でウイング状に配置されていることを特徴とする請求項1ないし3のいずれか1項に記載の赤外線検出装置。
【請求項5】前記赤外線反射器は、左右各々がパラボラ状の湾曲面を有することを特徴とする請求項1ないし4のいずれか1項に記載の赤外線検出装置。
【発明の詳細な説明】
【0001】
【発明の属する技術分野】本発明は、赤外線検出装置に関するもので、詳しくは赤外線検出器の視野外までも検知できる略全方向検知型の赤外線検出装置に関する。
【0002】
【従来の技術】一般に赤外線検出装置は、建物の壁面または天井等に取り付け、侵入者警報装置や自動ドア等の人体検知を主な目的として用いられている。
【0003】図7は、従来の赤外線検出装置を示す断面図である。ここで1は赤外線検出器、2は周辺回路を実装したプリント基板、3は集光レンズ、4はケース、5は金属キャップ、6は検出素子である。
【0004】赤外線検出器1は、周辺回路を実装したプリント基板2とケース4と集光レンズ3との中に納められている。このような構造の赤外線検出装置は特開昭62－147325号公報に示されている。
【0005】
【発明が解決しようとする課題】ケース4に納められた赤外線検出器1は、集光レンズ3を通して集光された赤外線を検出素子6で受け止める。この場合、赤外線検出装置の検知範囲は、赤外線検出器1の金属キャップ5の開口面積と検出素子6との距離によって大略定められる視野角によって制限される。図2の従来例に示すとおり



視野角は赤外線検出装置の前方100°程度、このときの検知距離は3m程度となり、このために、それ以上の角度の領域は視野外（非検出範囲）となっていた。
【0006】建物の壁面に赤外線検出装置を取り付けた場合には、より広角度な検出範囲が要求されている。これを解決する方法として、特開平1－217221号公報には、検出器の前方にフレネル型レンズの機能とミラーの機能を同時に備えた光学部品を設けた赤外線検出装置が示されている。しかしながら、広角度の検知が可能となったが、このような光学部品は、高価であり装置全体のコストが高くなってしまう。また装置全体が大型化してしまうなど欠点があった。
【0007】そこで、本発明は上記のような課題を解決するためになされたものであり、従来構造より大型化せずに、また、コストを比較的抑えながら検出範囲を広角度に設定できる赤外線検出装置を提供することを目的とするものである。
【0008】
【課題を解決するための手段】本発明に係る赤外線検出装置は、赤外線検出器と集光レンズを備えており、集光レンズは、赤外線検出器の視野内及び視野外の双方に配置されており、集光レンズと前記赤外線検出器との間には、赤外線反射器を備えており、赤外線反射器は、ウイング状に加工形成され、赤外線検出器の視野前方に切除部を有している赤外線検出装置である。
【0009】本発明に係る別の赤外線検出装置は、赤外線検出器が焦電形検出素子からなる赤外線検出装置である。
【0010】さらに別の赤外線検出装置は、集光レンズが複数個のレンズの集合体からなり、赤外線検出器の視野内のレンズによって集光された赤外線を切除部を通して赤外線検出器に入射させ、赤外線検出器の視野外のレンズによって集光された赤外線を赤外線反射器に反射させて赤外線検出器に入射させる赤外線検出装置である。
【0011】また、さらに別の赤外線検出装置は、赤外線反射器が赤外線検出器の中心に対して略左右対称でウイング状に配置されている赤外線検出装置である。
【0012】さらに、赤外線反射器の左右各々がパラボラ状の湾曲面を有する赤外線検出装置である。
【0013】
【発明の実施の形態】図1は本発明における赤外線検出装置を示す断面図である。ここで1は赤外線検出器、2は周辺回路を実装したプリント基板、3は集光レンズ、4はケース、5は金属キャップ、6は検出素子、7は赤外線反射器、8は固定部、9は切除部である。
【0014】赤外線検出器1は、周辺回路と共にプリント基板2上に実装し、ケース4と集光レンズ3とでできる空間内に納められている。
【0015】集光レンズ3は、赤外線検出器1の前方並び側面方向の赤外線を集光できるように複数個のレン

ズの集合体からなっている。複数個のレンズを備えることによって赤外線の焦点や入射方向を調整でき、検出素子6に赤外線を確実に入射させることができる。

【0016】赤外線検出器1の視野前方であって集光レンズ3との間には、赤外線反射器7が配置されており、接着等適宜手段により固定部8をケース4に固定している。

【0017】赤外線反射器7は、前記赤外線検出器正面を中心に対して略左右対称にウイング状に加工形成されており、赤外線検出器1の視野前方の一部分に切除部9を備えている。赤外線検出器1の視野内において集光レンズ3によって集光された赤外線は、切除部9を通過し、検出素子6に入射する。また、赤外線反射器7の左右各々の部材はパラボラ状の湾曲面を有する。パラボラ状の湾曲面にすることによって効率良く検出素子6に赤外線を入射することができる。

【0018】検出素子6は、焦電形検出素子を代表とする熱線感知素子からなり、赤外線を入射するための開口を備えた金属キャップ5内に納められている。赤外線検出装置の検知範囲は、金属キャップ5の開口面積及び金属キャップ5と検出素子6との距離によって大略定められる視野角によって制限されるものである。

【0019】この視野角によって制限されていた赤外線検出器1の略側面方向の赤外線は、集光レンズ3を通して集光された後に赤外線反射器7に反射して赤外線検出器1の検出素子6に入射することができる。

【0020】切除部9を有する赤外線反射器7を備えることによって略全方向（視野角約180゜）の赤外線を検知する赤外線検出装置を実現することができるようになった。これによって赤外線検出装置の設置された壁面の前方並びに側方の検知範囲の人体から放射される赤外線を感知して警報装置へ警戒信号を送出したり自動ドアの開閉信号を送出したりすることができる。

【0021】

【実施例】実施例に従って本発明をさらに詳細に説明する。

【0022】（実施例1）図3は、図1における赤外線反射器7の実施例を示す（a）斜視図と（b）正面図である。

【0023】図1で説明したように赤外線反射器7は集光レンズ3と赤外線検出器1との間に備えられており、図3（a）斜視図に示すように略左右対称にウイング状に加工形成されている。また、赤外線反射器7の切除部9はウイング状の左右各々の部材の付け根に当たる中央部に設けられており、赤外線検出装置の略正面方向からの赤外線が通過できるように取り付けており、図3（b）正面図の点線で囲まれた部分は赤外線検出器1の位置を示した部分である。

【0024】これによって、赤外線検出装置の略正面方向からの赤外線はレンズにより集光された後に赤外線検出器1に直接入射し、赤外線検出装置の略側面方向の赤外線はレンズにより集光された後に赤外線反射器7に反射して入射することができる。図2の実施例に示すとおり視野角は赤外線検出装置の前方約180゜程度まで拡大された。また、赤外線検出装置の視野角（約100゜）内の検知距離は従来と同等以上になる。

【0025】（実施例2）図4は、図1における赤外線反射器7の別の実施例を示す（a）斜視図と（b）正面図である。

【0026】実施例1と同様に赤外線反射器7は略左右対称にウイング状に加工形成されている。また、赤外線反射器7の切除部9はウイング状の左右各々の部材の中央線（図示せず）近傍を境に左右各々の部材に亘って設けられており、赤外線検出装置の略正面方向からの赤外線の略半分が通過できるように取り付けており、図4（b）正面図の点線で囲まれた部分は赤外線検出器1の位置を示した部分である。

【0027】これによって、赤外線検出装置の略正面方向からの赤外線は赤外線反射器7の切除部9を通過して赤外線検出器1に直接入射し、赤外線検出装置の略側面方向の赤外線は赤外線反射器7に反射した後、赤外線検出器1に入射することができる。

【0028】（実施例3）図5は本発明における別の赤外線検出装置を示す断面図である。ここでの断面はパラボラ状の湾曲部材の左右各々を亘る面で示している。また図6は、図5における赤外線反射器7の実施例を示す（a）斜視図と（b）正面図である。

【0029】図1で説明したように赤外線反射器7は集光レンズ3と赤外線検出器1との間に備えられており、図6（a）斜視図に示すように略左右対称にパラボラ状の湾曲面に加工形成されている。また、赤外線反射器7の切除部9はウイング状の左右各々の部材の中央線（図示せず）近傍を境に左右各々の部材に亘って設けられており、赤外線検出装置の略正面方向からの赤外線の略半分が通過できるように取り付けており、図6（b）正面図の点線で囲まれた部分は赤外線検出器1の位置を示した部分である。

【0030】これによって、赤外線検出装置の略正面方向からの赤外線は赤外線反射器7の切除部9を通過して赤外線検出器1に直接入射し、赤外線検出装置の略側面方向の赤外線は赤外線反射器7のパラボラ状の湾曲面に反射して集光されながら赤外線検出器1に入射することができ、集光効率を高め、検知距離を更に拡大することができる。

【0031】なお、ここでは示さなかったが赤外線反射器7の形状や切除部9の形状は四角形に限るものでは無く、赤外線検出装置や赤外線検出器1の形状に合わせたものを任意に選択できるものである。さらに、赤外線の入射を妨げない範囲であれば赤外線反射器7の切除部9の大きさや配置も1カ所に制限するものでは無く、複数

箇設けてもよい。また格子状に規則的に設けてもよく、あるいは不規則に設けてもよい。

【0032】

【発明の効果】赤外線反射器を設けることによって、赤外線検出器の金属キャップ5の開口面積及び金属キャップ5と検出素子6との距離によって大略制限されていた視野角は約180°まで大幅に拡大することが可能となる。

【0033】集光レンズを複数個のレンズの集合体にすることによって赤外線の焦点や入射方向を調整でき、検出素子に赤外線を確実に入射させることができる。

【0034】赤外線反射器の左右各々の部材をパラボラ状の湾曲面とすれば集光効率を高め、検知距離を更に拡大することができる。

【図面の簡単な説明】

【図1】本発明における赤外線検出装置を示す断面図

【図2】本発明並びに従来例における赤外線検出装置の検知範囲を示す図

【図3】図1における赤外線反射器を示す（a）斜視図、（b）正面図

【図4】図1における別の赤外線反射器を示す（a）斜視図、（b）正面図

【図5】本発明における別の赤外線検出装置を示す断面図

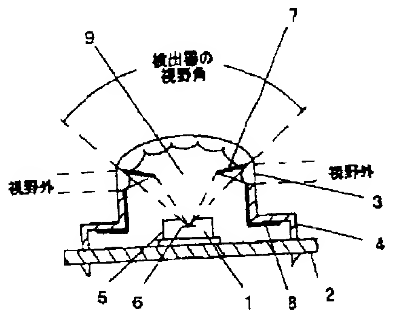
【図6】図5における赤外線反射器を示す（a）斜視図、（b）正面図

【図7】従来例の赤外線検出装置を示す断面図

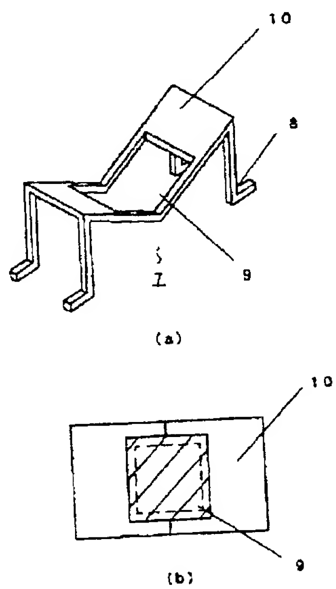
【符号の説明】

1：赤外線検出器
2：プリント基板
3：集光レンズ
4：ケース
5：金属キャップ
6：検出素子
7：赤外線反射器
8：固定部
9：切除部
10：反射部

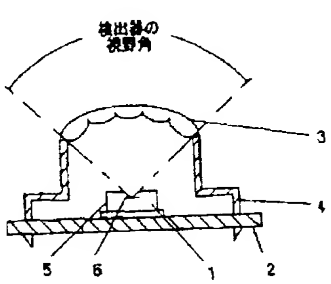
【図1】



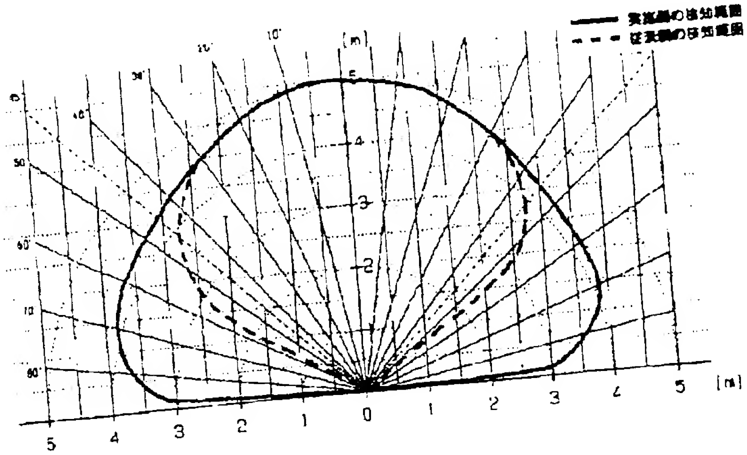

【図3】



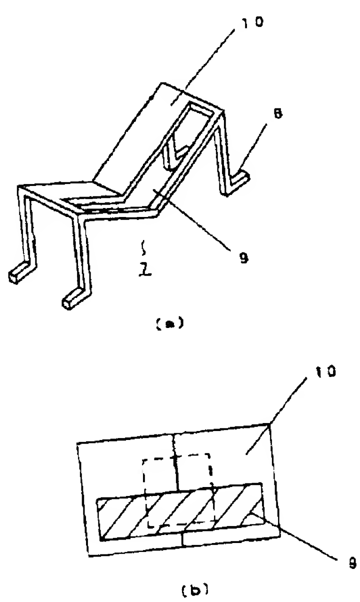

【図7】



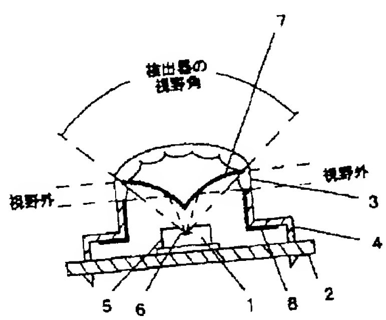
【図2】




【図4】




【図5】



【図6】

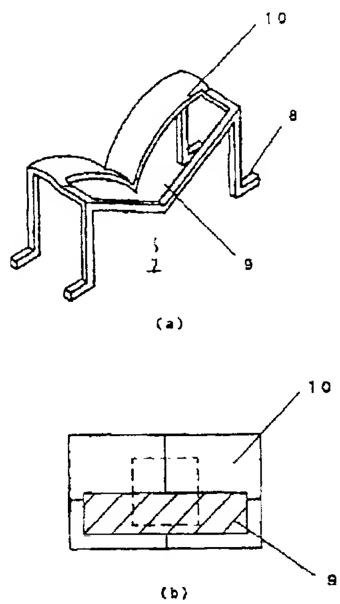


Figure 7 is a block diagram of an electronic signal processing arrangement.

Referring to Figure 1, infra-red detection apparatus in accordance with the invention has an outer housing 10 with a front aperture covered by a polyethylene film window 12 which is sufficiently thin to pass infra-red radiation having a wavelength typically in the region of 7 to 11 microns without significant absorption. As will be seen from both Figures 1 and 2, the window 12 has a lower part which is ribbed on one surface to form an array 14 of Fresnel lenses 14A to 14E having lens axes 14AA, 14BA, 14CA, 14DA and 14EA. The remainder of the window, i.e. the upper part 15, is generally parallel-sided and is smooth on both sides so as to pass radiation substantially without refraction. The housing, together with its window provides environmental protection and electrical screening. It will also be noted that the housing 10 is taller than it is deep.

Situated inside the lower part of the housing 10 are pyro-electric sensors 16A, 16B and 16C each containing one or more heat sensing elements and mounted adjacent each other in a horizontal line parallel to the window 12 in a metallic casing 18 which also contains electronic circuitry (not shown) for individually amplifying and filtering electrical signals produced by the sensors, as well as for generating an alarm signal or other response. The sensors 16A to 16C include integral long-pass optical filters allowing transmission of long infra-red wavelength radiation (i.e. longer than, for example, 7 microns), and are directed both towards the Fresnel lenses 14A to 14E and towards the upper part of the housing 10 so as to be sensitive to radiation incident directly from the window 12 and from the upper part of the housing. In order that radiation emanating from objects 25 metres or less from the apparatus is incident upon the sensors 16A to 16C, the latter are positioned at least approximately in the focal plane of the Fresnel lenses 14A to 14E at a level corresponding to the position of the image produced by a radiating object at the expected declination with respect to the window 12 for an object within that distance range, taking into account the intended mounting orientation of the housing 10 with respect to the horizontal and its height above ground. Fresnel lenses 14A to 14E

are, of course, positive, converging lenses formed on the inner or outer surface of the window 12.

Each sensor 16 preferably has two heat sensitive elements typically 1mm wide by 2mm high spaced apart by 1mm. Thus, when located on the focal plane of a collecting lens or mirror it will produce a field of view with a similar width-to-height ratio and a divergence dependent upon focal length. Typically, a focal length of 50mm results in a field of view approximately 300mm at 15 metres distance. The sensitivity of the sensor is such that an aperture of not less than f3 is preferred for reliable detection of an intruder at 15 to 20 metres with a focal length of 50mm. It will, therefore, be appreciated that, in order to detect an intruder reliably at, say, 60 metres range, the optical system requires a focal length of at least 100mm and an aperture preferably greater than f2. If a lens were to be used, its diameter would be in the region of 50mm. Such performance cannot be achieved reliably by means of a Fresnel lens made of an inexpensive infra-red transparent material such as polyethylene. A polyethylene lens suitable for passing the longer infra-red wavelengths without significant absorption must be comparatively thin, and since the material is soft and flexible, a lens formed from it displays a considerable lack of flatness resulting in optical aberration and a poorly defined field of view. For this reason, the present apparatus combines a Fresnel lens short range optical system with a mirror-based long range optical system, both using the sensors 16A to 16C. As shown in Figure 1 a concave mirror 20 (preferably having a parabolic or other conic section) is located oppositely with respect to sensors 16A to 16C in the housing 10, here in the upper part of the housing 10 with its reflecting concave surface facing downwardly and to the rear at a level corresponding to or slightly above the upper edge of the window 12. The upper part 15 of the window 12, above the Fresnel lenses 14A to 14E is parallel-sided for passing infra-red radiation substantially without refraction. A second, multi-faceted mirror 22, having three plane surfaces, is located to the rear of the housing 10 opposite the plane portion 15 of the window 12 with its reflecting surfaces directed forwardly and upwardly so as to direct incoming radiation emanating from objects at a distance of 25 metres or greater upwardly towards the focusing mirror 20. The focusing mirror 20 then

focuses such radiation on the sensors 16A to 16C which are located in a horizontal line along the focal plane. The precise positioning of the mirrors 20, 22 with respect to each other and with respect to the sensor 16 is such that radiation entering the window 12 at the angle of declination corresponding to a radiation source at a distance of 25 metres to, say, 60 metres is focused on the sensors 16A to 16C. It will be noted that the multi-faceted plane mirror 22 is positioned so as not to obstruct radiation reflected from the focusing mirror 20 onto sensors 16A to 16C, i.e. it is generally further from the window 12 than the sensors 16A to 16C. The optical axis of the focusing mirror 20 is inclined some 45° with respect to the horizontal, although other angles may be used. The multi-faceted plane mirror 22 is positioned to direct radiation entering the window 12 at an inclination of some 2° upwardly at a new inclination of some 45°. Thus, the housing 10 can be relatively small in depth and the window can be relatively close to the mounting surface. The focal length of the focusing mirror 20 is approximately 100mm, the focal point being on an offset axis 20A of the mirror located some 10mm below the front edge of the mirror and parallel to the field of view of the sensors 16A to 16C. The heat sensitive elements of each sensor 16A, 16B, 16C are located horizontally on either side of the respective sensor centre axis. The middle sensor 16B lies on the axis 20A at the focal point. As a result two long range fields of view are provided having a cross-sectional ratio of 2:1 with a divergence in the ratio 100:1 horizontally and 50:1 vertically, as shown by the reference numerals 24A, 24B, 24C and 25A, 25B, 25C in Figures 5 and 6. Further similar fields are also produced by the other two sensors 16A, 16C located on a horizontal plane either side of sensor 16B as shown by the reference numerals 26A to 26C, 27A to 27C, 28A to 28C and 29A to 29C.

When an intruder crosses the fields of view 24 to 29, infra-red energy due to body heat enters window 12, and is reflected by one of the plane mirror surfaces 22 onto focusing mirror 20 which then focuses the energy firstly onto one and then secondly on to the other of the heat-sensing elements of one of the sensors 16A to 16C. The connection of the heat-sensing elements is such that one element produces a positive-going electrical signal whilst the other element produces a negative-going signal so

that changes in ambient background temperatures produce opposing signals which cancel out, whereas an intruder crossing first one, and then the other field of view will produce a signal of one polarity followed by a signal of the other polarity.

Referring to Figure 7, the electronic circuitry coupled to the sensors 16A to 16C is arranged to detect such signal sequences in order to generate a movement detection signal which may be stored in electronic memory means 90, 91, 92 and further processed by a logic processor 93. Providing two or more memories contain a signal, then the logic processor 93 will activate an alarm relay timer 94.

The electronic signal processing arrangement is designed on the basis that while very large animals may be detected, their numbers are far fewer than smaller animals such as rabbits which have been shown from practical experience to be a significant cause of false alarms. Observation shows that rabbits do not generally move at a linear speed but tend to move intermittently, spending much time in one location before moving and stopping at another to eat. Intruders on the other hand, tend to move steadily across successive fields of view.

Motion signals from adjacent fields of view are allocated to separate processing channels so that signal storage and logic processing may be used to reduce significantly false alarms from small animal movements. The nine main fields of view are arranged as three groups of three (left-centre-right repeated three times) to provide separate signal sources for electronic processing by three separate processors. Signals meeting specific requirements of amplitude, frequency and duration may be stored in an electronic memory for a preset time but not used to signal an alarm. An electronic logic circuit monitors the contents of the three stores and will only signal an alarm condition if any two of three stores contain an intrusion signal. A movement generated signal will only be held in a memory for a predetermined time interval, typically 10-15 seconds, so that, for instance, a rabbit moving into a field of view may be detected and cause a signal to be stored but is unlikely to move into an adjacent field of view within the time interval, whereas an intruder is most likely to move across more than two fields of view within the

allotted time. The number of channels used, the logic conditions and time periods may be varied to suit individual site and security requirements.

Referring again to Figures 1 to 3, sensors 16A to 16C are located adjacent to each other in a horizontal line, the centre sensor 16B being located on the mirror axis 20A of the concave mirror 20 at the focal point with the other two sensors 16A and 16B spaced equidistantly on each side.

Each sensor contains typically two heat sensing elements 1mm wide by 2mm high spaced 1mm apart horizontally on either side of the sensor central axis. As a result, two fields of view are produced from each sensor having a cross-sectional ratio of 2:1 with a divergence ratio 100:1 horizontally and 50:1 vertically, as shown by reference numerals 24A to 24C, 25A to 25C, 26A to 26C, 27A to 27C, 28A to 28C and 29A to 29C, in Figures 5 and 6.

If mirror 22 were a single plane mirror, then the three sensors 16A to 16C would produce three spaced apart double fields of view with a divergence proportional to the displacement of the outer sensors about axis 20A. However, since mirror 22 has three plane mirror surfaces 22A, 22B, 22C with the outer two surfaces 22A and 22C inclined inwardly towards the centre mirror surface 22B at angle A and downwardly at angle B, three divergent areas of coverage are created each having three double fields of view produced by the three sensors. Referring to Figure 6 the three fields of view 26A and 27A are produced by sensor 16A. The three fields of view 24B and 25B are produced by sensor 16B and the three fields of view 28C and 29C are produced by sensor 16C. It can been seen that an intruder moving across the protected area from say left to right in Figure 6 would produce detection signals at sensor 16A, then 16B, and then 16C with the sequence repeating as further fields of view are crossed. Providing the intruder moves across any two fields of view within the memory pre-set time interval, an alarm condition may be activated.

The four ranks of fields of view below the main rank 24 to 29 are produced by a Fresnel lens array located in the lower part 14 of window 12 (Figure 2).

Lenses forming the array 14 are positive collecting lenses and have a common focal length. Each lens axis is located at suitable positions to produce divergent and declining fields of view to cover the area below the main rank.

Referring to Figures 2, 5 and 6, lens 14A produces fields of view 42A to 47C shown in Figure 5 and also fields of view 60A to 65C from curved secondary mirror 28. Lens 14B produces fields of view 36A to 41C and also fields of view 54A to 59C from curved secondary mirror 28. Similarly lens 14C produces fields of view 30A to 35C and 48A to 53C. Lens 14D produces fields of view 72A to 77C and 84A to 89C from curved secondary mirror 28. Similarly lens 14E will produce fields of view 66A to 71C and 78A to 83C.

It will be apparent to those skilled in the art that the number and radial spacing of the fields of view may be varied to produce coverage patterns available with a multiplicity of sensing elements variously configured to produce a series of positive- and negative-going electrical signals. If, therefore, the double element sensors described earlier were to be replaced by sensors having say, four elements, then the number of fields of view would double.

Further increases in the number of fields of view can be obtained by having more than three dual-element sensors placed at advantageous positions (either adjacent horizontally, or vertically above each other to form additional declining fields of view).

An increased number of fields of view may also be obtained by use of a multi-faceted plane mirror array having more than three inclined facets.

It will also be appreciated that the radial area of coverage may be varied from the preferred arrangement described earlier by variation of the relative spacing of the

sensors or by changes in the relative inclination of the outer plane mirror facets of the secondary mirror array.

Although detection apparatus providing various field of view layouts may be manufactured as different models, it is possible to include means to adjust the angle of the outer plane mirror facets during or after installation, enabling a user to adjust the area of coverage to match, say, a particular CCTV camera coverage. This adjustment may be carried out manually by means of adjustment screws.

Alternatively, such adjustment may be carried out automatically by use of electric motors or solenoids within the detector housing and controlled from a remote point such as a CCTV monitoring control room. This would enable a remote camera operator to vary the angle of coverage to match changes in the camera lens coverage as may occur when zoom lenses are used.

In a further embodiment the area of coverage may be varied automatically using electrical command signals from, say, a CCTV camera zoom lens remote controller. Thus the motion sensor will always cover the area covered by the camera lens automatically without operator intervention.

It will be appreciated that the electronic processing system described earlier may use more than three channels when more than three sensors are used and that the storage times may be extended or reduced as required. Also the electronic logic system may signal an alarm with combinations other than the 'any two from three' arrangement described.

For example, in installations where there are high numbers of animals and a relatively low security requirement, it may be advantageous to require all electronic stores to contain a motion signal before an alarm is initiated. Conversely, in a high security application with little or no risk of animal activity, it may be advantageous to signal an alarm condition when any one of the stores receives a motion signal.

It will be appreciated that as an intruder crosses sequentially through adjacent fields of view, motion signals will be stored sequentially and may be used to indicate the direction of movement of the intruder.

In a practical embodiment the user may select by means of switches, various logic configurations and storage times to suit the environment.

It will be appreciated that the amplifier and signal processing circuits in each channel may not necessarily be similar. For example, channels used to process signals from the outer (widest angle) fields of view may use higher or lower gain amplification and wider or narrower frequency pass bands in order to compensate for optical losses.

The apparatus described above may be summarised as an infra-red intrusion detector system having a multiplicity of pyro-electric sensors with long pass infra-red filter means, a focusing mirror, a polyethylene film window having a smooth area and a focusing Fresnel lens array. A multi-faceted reflector is located within the field of view of the focusing mirror between that mirror and the polyethylene window. A secondary cylindrically curved reflector is located between the sensor and the Fresnel lens array, the sensor being located substantially at the common focal point of the focal mirror and the Fresnel lens array to produce discrete spaced-apart fields of view. The focusing mirror has a focal length substantially longer than the focal length of the Fresnel lens array to produce relatively narrow long range fields of view in comparison to the fields of view obtained with the Fresnel lens.

Electronic means are employed to process and store separately intrudèr generated signals and to signal an alarm condition if any two stores contain signals simultaneously within a predetermined time interval.

The Fresnel lens or lens array may be separately located from the smooth window portion. It is also possible to use materials other than polyethylene which transmit

infra-red radiation, for example germanium or silicon. This applies both to the Fresnel lens or lens array and to the smooth part of the window.

Uses of the apparatus in addition to intruder detection may include the control of internal or external lighting, and the control of observation cameras, for example.

## CLAIMS

1. Infra-red detection apparatus comprising an infra-red sensor array mounted in a housing, a focusing reflector system constructed and arranged in the housing to focus infra-red radiation received from a first range of distances onto the array, and a focusing refractor constructed and arranged in the housing to focus infra-red radiation from a second range of distances onto the array, the second distance range encompassing distances shorter than the first distance range, wherein the sensor array comprises at least three sensing element or groups of sensing elements, which elements or groups are spaced apart transversely with respect to a lens axis of the focusing refractor, and wherein the focusing reflector system includes a multiple reflector having at least three reflector surfaces each oriented to direct incoming radiation to a different transverse position on the sensor array.

2. Apparatus according to claim 1, wherein the housing has a front window forming at least part of a front wall of the housing and the reflector system comprises a first mirror mounted within the housing in a rearward position with respect to the window and directed generally towards the window, and a second mirror above or below the window and the first mirror and directed generally towards the first mirror, the sensor array being respectively below or above the window and the first mirror, whereby infra-red radiation entering the housing through the window is reflected by the first mirror onto the second mirror where it is then reflected onto the sensor array.

3. Apparatus according to any preceding claim, wherein the multiple reflector is a single multi-faceted mirror having three or more facets angled with respect to each other.

4. Apparatus according to claim 1 or claim 2, wherein the multiple reflector is a group of mirrors angled with respect to each other.

5. Apparatus according to any preceding claim, wherein the focusing reflector system comprises a plane reflector and a concave reflector.

6. Apparatus according to claim 5, wherein the plane reflector is the multiple reflector.

7. Apparatus according to claim 5, wherein the concave reflector is the multiple reflector and has a plurality of concave facets or sections each having a focusing axis angled with respect to the axes of the other facets or sections.

8. Apparatus according to any preceding claim, wherein the sensor array comprises a number of sensors which corresponds to the number of reflector surfaces of the multiple reflector.

9. Apparatus according to claim 8, wherein each sensor comprises two or more sensing elements.

10. Apparatus according to claim 9, wherein the sensing elements of each sensor are arranged side-by-side in a transverse direction.

11. Apparatus according to any preceding claim, wherein the focusing refractor has a plurality of lenses with differently oriented lens axes.

12. Apparatus according to claim 11, wherein the lens axes are arranged to produce fields of view spaced vertically so as to define different ranges corresponding to different declinations with respect to the horizontal.

13. Apparatus according to any preceding claim, wherein each sensing element or group of sensing elements is connected to an electronic signal processing arrangement constructed so that an alarm condition is signalled only when at least two sensor output signals occur at different respective sensor outputs within a predetermined time interval.

14. Apparatus according to claim 13, wherein the sensor output signals are changes in the voltage level of one or more sensing elements of the sensor.

15. Apparatus according to claim 13, wherein the sensor output signals are changes in the difference between the output voltage levels of two sensing elements of a sensor.

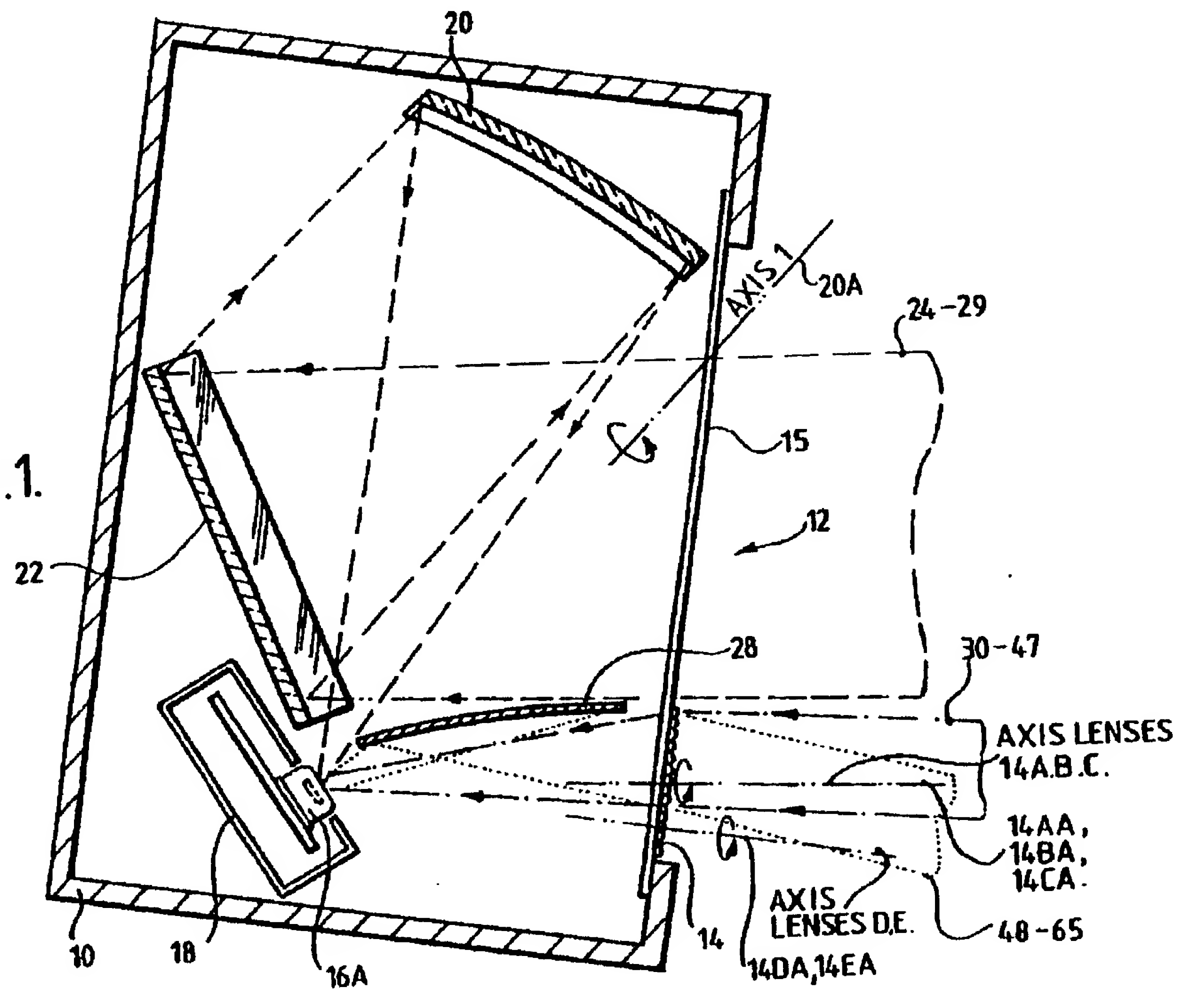
16. Apparatus according to any preceding claim, comprising an additional reflector located in the housing and arranged to reflect radiation from the focusing refractor onto the sensor array in addition to the radiation focused directly onto the array by the focusing refractor.

17. Apparatus according to claim 16, wherein the additional reflector is a curved mirror.

18. Apparatus according to any preceding claim, wherein the focal length of the focusing refractor is less than that of the focusing reflector.

19. Infra-red detection apparatus constructed and arranged as herein described with reference to the drawings.

FIG.1.


20
AXIS 1
20A
24-29
15
12
22
28
30-47
AXIS LENSES
14A.B.C.
14AA,
14BA,
14CA.
AXIS
LENSES D.E.
48-65
10
18
16A
14
14DA,14EA

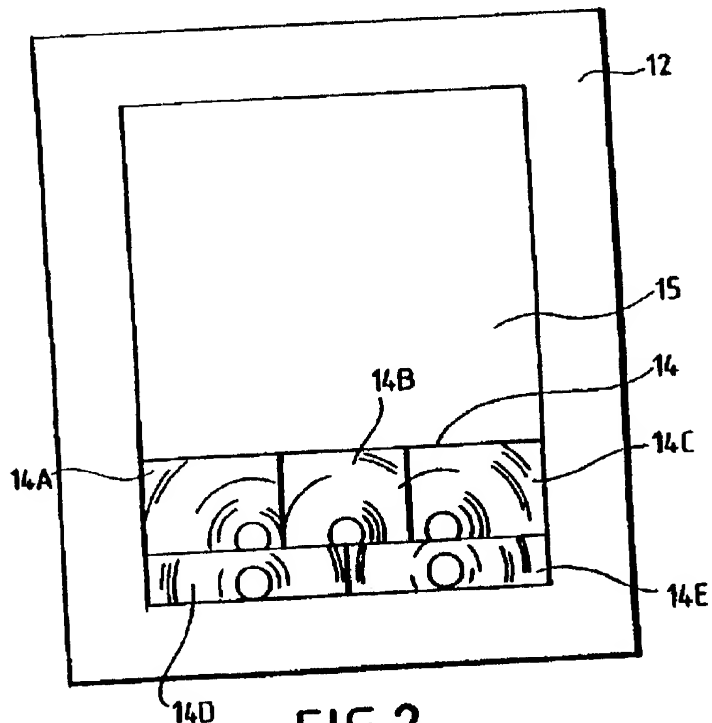

12
15
14B
14
14A
14C
14E
14D

FIG.2.

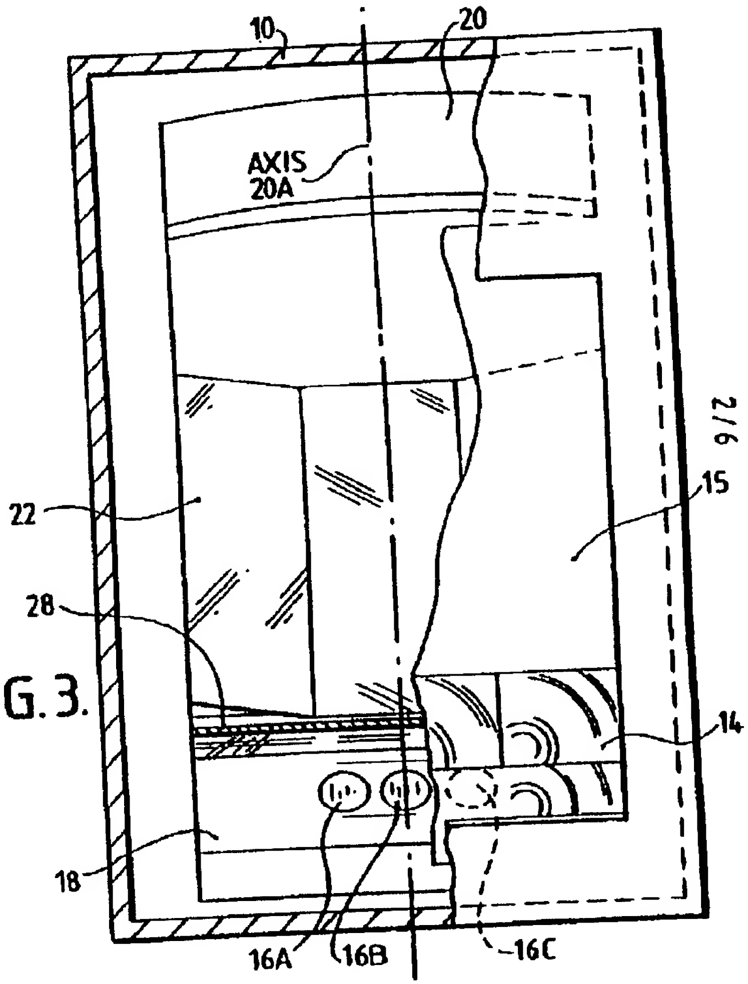

10
20
AXIS
20A
22
15
28
14
18
16A
16B
16C

FIG.3.

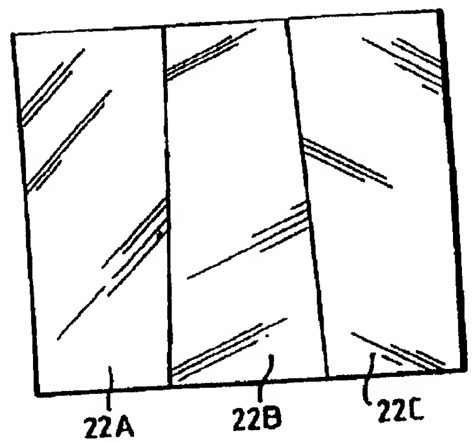



FIG.4A.

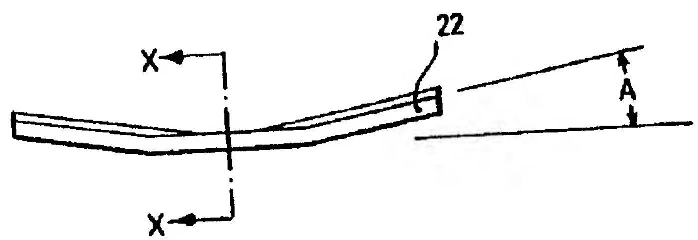



FIG.4B.

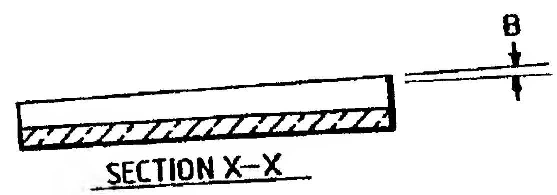
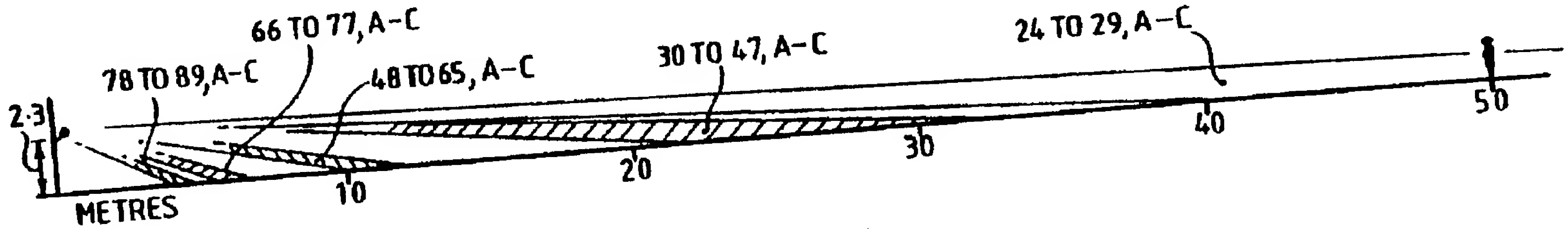
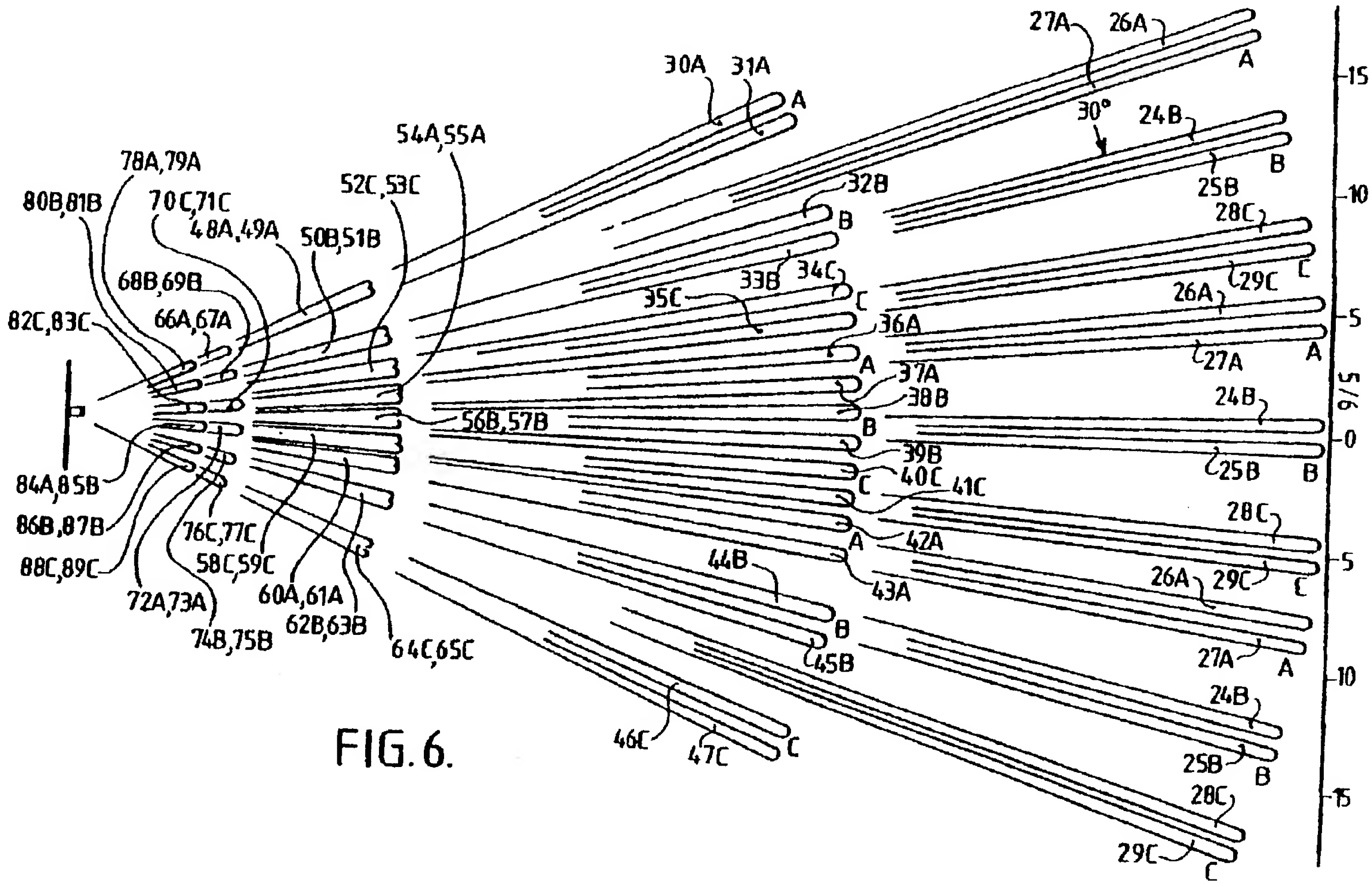



FIG.4C.



2·3
1
METRES
10
20
30
40
50
78 TO 89,A–C
66 TO 77, A–C
48 TO 65, A–C
30 TO 47, A–C
24 TO 29, A–C


FIG.5.



27A
26A
A
30°
24B
25B
B
30A
31A
A
15
10
5
5/6
0
5
10
15
32B
B
28C
29C
C
26A
27A
A
24B
25B
B
78A,79A
54A,55A
52C,53C
80B,81B
70C,71C
48A,49A
50B,51B
68B,69B
82C,83C
66A,67A
35C
33B
34C
C
36A
A
37A
38B
B
56B,57B
39B
40C
C
41C
28C
42A
A
43A
44B
B
45B
26A
29C
C
27A
A
24B
25B
B
28C
29C
C
84A,85B
86B,87B
76C,77C
88C,89C
58C,59C
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74B,75B
62B,63B
64C,65C
46C
47C
C


FIG.6.

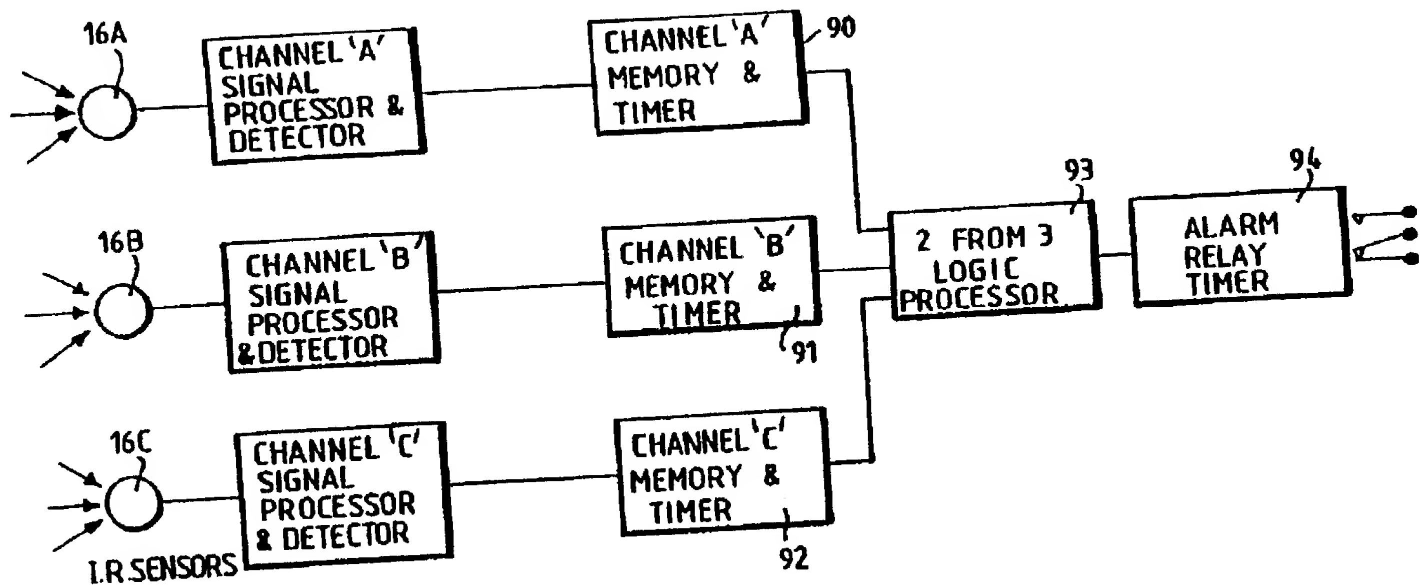
16A
CHANNEL 'A' SIGNAL PROCESSOR & DETECTOR
CHANNEL 'A' MEMORY & TIMER
90
16B
CHANNEL 'B' SIGNAL PROCESSOR & DETECTOR
CHANNEL 'B' MEMORY & TIMER
91
16C
CHANNEL 'C' SIGNAL PROCESSOR & DETECTOR
CHANNEL 'C' MEMORY & TIMER
92
I.R SENSORS
93
2 FROM 3 LOGIC PROCESSOR
94
ALARM RELAY TIMER

FIG. 7.